PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Use of age-specific hospital catchment populations to investigate geographical variation in inpatient admissions for children and young people in England: retrospective, cross-sectional study.
AUTHORS	Arora, Sandeepa; Cheung, R; Sherlaw-Johnson, Christopher; Hargreaves, Dougal

VERSION 1 – REVIEW

REVIEWER	Tony Gatrell Faculty of Health & Medicine Lancaster University Lancaster LA1 4YW UK
REVIEW RETURNED	26-Feb-2018

| GENERAL COMMENTS | This is a very nice paper and I congratulate the authors. I only have a few remarks.

I found the notation somewhat unusual and wonder if it might be simplified. As a geographer, I would normally expect locations (of hospitals, LSOAs, etc.) to be referenced with subscripts i or j, and counts to be referenced with lower case n. So I wonder if we might see the number, n, of children in age/sex band k (say), from LSOA i referred to provider j. As I say, that is personal preference, but it removes the need for Greek characters!

If readers may struggle – as the authors suggest – what the notion of a 'Trust' they may also struggle with 'LSOA'. Perhaps a sentence explaining that these are the most fine-grained spatial units for which Census data are available, would help?

I could not see what, precisely, were the age bands used.

I was not entirely sure why one would wish, in a paediatric context, to distinguish males from females. Does this help in any service planning context at all? Perhaps worth a comment or justification?

The illustration using epilepsy is helpful. However, I wondered if some comment is merited as to the possible causes of variation (as per the funnel plots)?

On page 15, line 9 mention is made of possible 'detailed maps'. I wondered what form these would take? Are the authors suggesting choropleth maps showing the proportion of children from each LSOA attending each provider? If so, that might be made explicit.

There is a minor typo on page 9, line 23 where the subscript should be lower case i, not upper case. |
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REVIEWER	Michael Falster
	Centre for Big Data Research in Health, UNSW Sydney, Australia
REVIEW RETURNED	09-Mar-2018

| GENERAL COMMENTS | This paper sought to define population catchments of paediatric patients for NHS Trusts in the UK, using (primarily) administrative hospital inpatient data. The paper was very well written, clear in it's approach and used appropriate methodology. I had no major concerns with the paper, and thought it was a pleasure to read.

If there was an issue it may be that more advanced methods for creating hospital patients catchments are available. Similar methods for developing hospital patient catchments have been used in the UK to calculate 'rates' of preventable hospitalisation (e.g. O'Cathain Health Serv Manage Res 2013;26(4):110), alternate approaches to defining population catchments have been able to capture the underlying need of the population for services (e.g. Shwartz Med Care 2011;49:162, Falster Health Serv Res 2018), as well as new automated means for defining hospital service areas which somewhat reflect the analysis which has been performed here (Hu Health Serv Res 2018;53:236). Still, there is a need for research articles which clearly demonstrate the methods for constructing hospital population catchments, and those used in this paper seem appropriate for their proposed policy use, and the authors have referred to some alternate methods and limitations of their approach.

Minor comments
1. Table 2 is very large. I wonder if this would be better suited as an appendix, with a table summarising the distribution of the three types of admission instead (I note this is already reported in the text).

2. I am curious about whether rates of all-cause and epilepsy admissions are correlated (from the table it appears not very much).

3. There doesn't seem to be a need for both panels in Figure 1, as all the data in presented already in the lower panel. Was there a reason that a corresponding figure for all-cause admissions was not included? |

VERSION 1 – AUTHOR RESPONSE

Reviewer(s)' Comments to Author:

Reviewer: 1

Reviewer Name
Tony Gatrell

Institution and Country
Faculty of Health & Medicine
Lancaster University
Lancaster LA1 4YW
UK

Please state any competing interests or state 'None declared':

None declared

Please leave your comments for the authors below
This is a very nice paper and I congratulate the authors. I only have a few remarks.

1. I found the notation somewhat unusual and wonder if it might be simplified. As a geographer, I would normally expect locations (of hospitals, LSOAs, etc.) to be referenced with subscripts i or j, and counts to be referenced with lower case n. So I wonder if we might see the number, n, of children in age/sex band k (say), from LSOA i referred to provider j. As I say, that is personal preference, but it removes the need for Greek characters!

Response: We take on board the concern about the potential confusion that can be caused by unconventional notation. We have therefore changed the formulae so that the LSOAs are denoted with a "j" and the numbers admitted with "m" (the reviewer's preference of "n" was already used to denote catchment populations). Following convention, we have kept the delta function in step 5.

2. If readers may struggle – as the authors suggest – what the notion of a 'Trust' they may also struggle with 'LSOA'. Perhaps a sentence explaining that these are the most fine-grained spatial units for which Census data are available, would help?

Response – agreed. We have amended the wording accordingly in the first paragraph of the Methods section.

3. I could not see what, precisely, were the age bands used.

Response: Thank you for the opportunity to clarify that we used single year of age for all analyses (ie no age bands were used). We have amended the text in the first paragraph of the methods section to clarify this point.

4. I was not entirely sure why one would wish, in a paediatric context, to distinguish males from females. Does this help in any service planning context at all? Perhaps worth a comment or justification?

Response: Thank you. Males have consistently higher rates of inpatient admissions than females among younger patients (0-12 years) and this pattern is reversed among older adolescent (14+). We have revised the first section of the Methods section to explain this point and we have added an additional reference on this topic for interested readers.

5. The illustration using epilepsy is helpful. However, I wondered if some comment is merited as to the possible causes of variation (as per the funnel plots)?

Response: Detailed analysis of the causes of variation are beyond the scope of this study. However, we have revised the last paragraph of the results section to clarify that size of unit and population characteristics account for relatively little of the observed variation.
We have also revised the final paragraph of the discussion section to highlight that variation in service quality (as measured by performance on the national clinical audit) may account for some of the observed variation and that this is an interesting area for future research.

6. On page 15, line 9 mention is made of possible 'detailed maps'. I wondered what form these would take? Are the authors suggesting choropleth maps showing the proportion of children from each LSOA attending each provider? If so, that might be made explicit.

Response: Yes, chloropleth maps are exactly the kind of maps that we suggest. The text has been revised to clarify this point (see paragraph 6 of discussion section).

7. There is a minor typo on page 9, line 23 where the subscript should be lower case i, not upper case.

Response. Thank you, this has been corrected.

Reviewer: 2

Reviewer Name
Michael Falster

Institution and Country
Centre for Big Data Research in Health, UNSW Sydney, Australia

Please state any competing interests or state 'None declared':
None

Please leave your comments for the authors below
This paper sought to define population catchments of paediatric patients for NHS Trusts in the UK, using (primarily) administrative hospital inpatient data. The paper was very well written, clear in it's approach and used appropriate methodology. I had no major concerns with the paper, and thought it was a pleasure to read.

8. If there was an issue it may be that more advanced methods for creating hospital patients catchments are available. Similar methods for developing hospital patient catchments have been used in the UK to calculate 'rates' of preventable hospitalisation (e.g. O'Cathain Health Serv Manage Res 2013;26(4):110), alternate approaches to defining population catchments have been able to capture the underlying need of the population for services (e.g. Shwartz Med Care 2011;49:162, Falster Health Serv Res 2018), as well as new automated means for defining hospital service areas which somewhat reflect the analysis which has been performed here (Hu Health Serv Res 2018;53:236). Still, there is a need for research articles which clearly demonstrate the methods for constructing hospital population catchments, and those used in this paper seem appropriate for their proposed policy use, and the authors have referred to some alternate methods and limitations of their approach.

Response:
We are very grateful for these thoughtful comments. In response, we have revised and expanded our limitations section to include some of these additional references and provide the reader with a richer background to our study (see 4th paragraph of the discussion section).

Minor comments
9. Table 2 is very large. I wonder if this would be better suited as an appendix, with a table summarising the distribution of the three types of admission instead (I note this is already reported in the text).

Response: Thank you for this suggestion. Our experience in presenting these data to clinicians, managers and commissioners working in paediatrics, is that their first instinct and main interest is to look up their own Trust. Our preference would therefore be to keep Table 2 as it is, in order to facilitate clinicians and others to do this as easily as possible. We also note that BMJ Open is an online only journal and that tables can easily be collapsed to facilitate reading the article text.

However, we would happy to defer to the editors' judgement if it is felt that this table would sit better as an Appendix.

10. I am curious about whether rates of all-cause and epilepsy admissions are correlated (from the table it appears not very much).

Response: There is a moderate correlation between the two ($r2 = 0.25$). We have added this information to the penultimate paragraph of the results section.

11. There doesn't seem to be a need for both panels in Figure 1, as all the data in presented already in the lower panel. Was there a reason that a corresponding figure for all-cause admissions was not included?

Response: Thank you. We agree that the duplication between the two panels is not necessary and have deleted the top panel. The figure is intended to be purely illustrative, so we feel that the epilepsy data alone make this point, and a corresponding figure for all-cause admissions is not needed.

FORMATTING AMENDMENTS (if any)
Required amendments will be listed here; please include these changes in your revised version:
12- Kindly re-upload FIGURE with at least 300 dpi resolution in either TIFF or JPG format.

Response: done

13. Please include Figure legends at the end of your main manuscript.

Response: done

14. Kindly re-upload APPENDIX TABLES in PDF format.

Response: done

15. You have cited appendix table a5 prior to appendix table a1 which makes your citations incorrect. Please review again your main document and ensure that all appendix tables will be cited and will appear in ascending order.

Response: done